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Incorporating Indirect Costs into a Cost-Benefit Analysis of Laparoscopic Adjustable Gastric Banding

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A B S T R A C T

Objectives: The objective of this study was to estimate the time to breakeven and 5-year net costs of laparoscopic adjustable gastric banding (LAGB) taking both direct and indirect costs and cost savings into account. **Methods:** Estimates of direct cost savings from LAGB were available from the literature. Although longitudinal data on indirect cost savings were not available, these estimates were generated by quantifying the relationship between medical expenditures and absenteeism and between medical expenditures and presenteeism (reduced on-the-job productivity) and combining these elasticity estimates with estimates of the direct cost savings to generate total savings. These savings were then combined with the direct and indirect costs of the procedure to quantify net savings. **Results:** By including indirect costs, the time to breakeven was reduced by half a year, from 16 to 14 quarters. After 5 years, net savings in medical expenditures from a gastric banding procedure were estimated to be \$4970 (±\$3090). Including absenteeism increased savings to \$6180 (±\$3550). Savings were further increased to \$10,960 (±\$5864) when both absenteeism and presenteeism estimates were included. **Conclusions:** This study presented a novel approach for including absenteeism and presenteeism estimates in cost-benefit analyses. Application of the approach to gastric banding among surgery-eligible obese employees revealed that the inclusion of indirect costs and cost savings improves the business case for the procedure. This approach can easily be extended to other populations and treatments.

Keywords: bariatric surgery, business case, obesity, return on investment.

Introduction

Recent evidence reveals that the direct (medical) and indirect (productivity loss) burden of severe obesity, defined as having a body mass index (BMI) greater than 40 kg/m^2, is substantial [1]. Bahr et al. [2] showed that annual obesity-attributable medical expenditures for the severely obese could be as high as \$1270 for males and \$2530 for females. Furthermore, they showed that the indirect costs resulting from severe obesity, which include increased absenteeism and health-related reductions in productivity while at work (termed presenteeism), comprised an even larger share of total obesity-attributable costs. They estimated annual indirect obesity-attributable costs of \$6090 for severely obese male employees and \$6690 for severely obese female employees.

Because of the high costs resulting from severe obesity, effective obesity interventions have the potential to generate significant savings. To date, the most effective intervention for severe obesity is bariatric surgery; the two most common types of bariatric surgery are gastric bypass surgery and gastric banding. Both procedures have been shown to be cost-effective when focusing on direct medical expenditures [3–8].

Estimating changes in direct medical expenditures after a medical/surgical intervention is easily accomplished because of readily available longitudinal medical claims data. Similar data do not exist for estimating indirect costs. As a result, nearly all cost-effectiveness and cost-benefit studies focus solely on direct costs.

Given that a bariatric procedure not only generates short-term work loss but also has the potential to reduce subsequent absenteeism and presenteeism, the largest components of obesity-related costs, and because employers are ultimately responsible for making coverage decisions for their employees, a lack of information on potential indirect cost implications resulting from bariatric procedures is a significant limitation.

The objective of this study was to estimate the time to breakeven and 5-year net costs of laparoscopic adjustable gastric banding (LAGB) taking both direct medical and indirect absenteeism and presenteeism costs and cost savings into account. Although longitudinal data on indirect cost savings are not available, indirect cost savings were generated by estimating the relationship between medical expenditures and absenteeism and between medical expenditures and presenteeism and combining these estimates with estimates of the direct cost savings. Although the analysis focuses on LAGB as a treatment for severe obesity, this approach can easily be applied to gastric bypass or extended to other populations and treatments.

Methods

Methodological overview

The estimation strategy occurred in four steps. First, estimates of quarterly percentage reductions in direct medical cost savings

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doi:10.1016/j.jval.2011.12.004

post-LAGB (termed α_i, where i denotes the quarter postprocedure) were derived from published literature [9]. Second, an elasticity was calculated that quantifies the percentage change in absenteeism for a given percentage change in medical expenditures (termed β). Multiplying each α_i times β allows for estimating quarterly percentage reductions in absenteeism postbanding. Third, because no data set exists that allows for directly estimating the percentage change in presenteeism for a given percentage change in medical expenditures, this estimate was calculated indirectly by quantifying the percentage change in presenteeism for a given percentage change in absenteeism, termed δ. This estimate was then multiplied by β and then by each α_i to estimate quarterly percentage savings in presenteeism postprocedure. Fourth, all savings were monetized and then combined with the direct and indirect costs of the procedure to quantify net costs. The data and a more detailed estimation approach are described below.

Data

The medical expenditure/absenteeism elasticity (β) was estimated by using the publicly available Medical Expenditure Panel Survey (MEPS)—a nationally representative survey of the civilian noninstitutionalized population that quantifies an individual's total annual medical spending by type of service and source of payment. This includes all expenditures for office-based visits, hospital outpatient visits, emergency room visits, hospital inpatient stays, home health care, dental care, vision aids, other medical equipment and services (e.g., orthopedic items, medical equipment, disposable supplies), andprescription medicines. The survey also includes the following question in each interview round that allows for quantifying annual work loss due to illness or injury: "How many days did [respondent] miss a half day or more of work due to health problems?"

Other questions capture employment status, self-reported weight and height, and sociodemographic characteristics of respondents. The MEPS sample was limited to full-time, nonpregnant employees between the ages of 18 and 64 years (N = 18,143). For the primary analysis, the sample was further limited to those eligible for bariatric surgery, which includes those with a BMI of more than 40 or between 35 and 40 with a significant comorbidity, including sleep apnea, cardiovascular disease, osteoarthritis, or diabetes (n = 876), and to those respondents with data in both 2005 and 2006 (n = 134 individuals representing 268 observations). To gauge the sensitivity of the elasticity estimate to sample selection, supplemental analyses were conducted on the larger samples.

MEPS does not include questions on presenteeism. Both absenteeism and presenteeism, however, are included in the proprietary National Health and Wellness Survey (NHWS), although it does not capture medical expenditures. Therefore, the 2008 NHWS cross-sectional data set was used to quantify the absenteeism/presenteeism elasticity (δ). NHWS is a self-administered, Internet-based questionnaire that focuses on the health status and healthcare attitudes, behaviors, and outcomes of adults aged 18 years or older. It is fielded to 63,000 members of an Internet-based consumer panel and is designed to be representative of the US adult population. NHWS captures absenteeism and presenteeism by using the Work Productivity and Activity Impairment (WPAI) index.

The WPAI index is a validated questionnaire, commonly used across various occupations and disease areas to assess employee productivity losses related to health [10]. Absenteeism is measured by using the following question: "During the past seven days, how many hours did you miss from work because of your health problems?" Presenteeism is assessed with the following question, "During the past seven days, how much did your health problems affect your productivity while you were working?" Participants indicate their level of work impairment via a rating scale ranging from 0 to 10, with 0 indicating that "health problems had no effect on my work" and 10 indicating that "health problems completely prevented me from working." Each response is assumed to represent a percentage reduction in productive work due to health problems (e.g., a respondent reporting a value of 3 is assumed to have a 30% reduction in productive work, whereas a respondent reporting a 10 is assumed to be completely unproductive while at work).

NHWS also includes questions similar to those in MEPS that capture self-reported height and weight, employment status, and other sociodemographic characteristics. Other than the requirement of being in two consecutive years of data (data for only 1 year were available for the analysis), the same sample restrictions were applied as for the MEPS data. The primary analysis sample included 2164 individuals who were full-time employees and eligible for LAGB; supplemental analyses were run on the larger sample.

Estimation of indirect costs

MEPS provides annual estimates for medical expenditures and absenteeism. To annualize the WPAI index data, each respondent's absenteeism estimate was divided by 8 (to convert it from hours to days) and multiplied by 50, the estimated number of workweeks in a year. The presenteeism percentage was multiplied by 250 (the number of workdays per year) to estimate the number of workdays per year that the individual was unproductive at work due to health problems.

Using the annualized values for medical expenditures, absenteeism, and presenteeism, regression modules of the following form were used to estimate the elasticities:

$$\log(\mathrm{ABS}_i) = \beta \log(\mathrm{MED}_i) + \lambda Z_i + \varepsilon_i$$
$$\log(\mathrm{PRES}_i) = \delta \log(\mathrm{ABS}_i) + \eta Z_i + \nu_i$$

The log-log specification has the advantage that the coefficients on $\log(\mathrm{MED}_i)$ and $\log(\mathrm{ABS}_i)$ are estimated elasticities. In the MEPS model, with annual absenteeism days as the dependent variable and annual medical expenditures as the key independent variable, this coefficient is a direct estimate of β, the percentage change in absenteeism for a given percentage change in medical expenditures. In the NHWS model, with annual presenteeism days as the dependent variable and annual absenteeism days as the key independent variable, this coefficient provides an estimate of δ; multiplying this estimate times β provides an estimate of the percentage change in presenteeism for a given percentage change in medical expenditures.

Although the log-log model is a convenient method for estimating elasticities, it is problematic when the logged variables include a large percentage of zeros, as was the case for the medical expenditures, absenteeism, and presenteeism variables. To ensure that individuals with zeros for these variables were not dropped from the models, in the primary specification 0.1 days were added to all zero absenteeism and presenteeism days and $1 was added for all individuals who had no medical expenditures during the year. Supplemental analyses—which included 1) analyses on only those with positive values for these variables, 2) generalized linear models that did not require log transformations, and 3) larger adjustment factors—tested the robustness of this approach. We also explored the effects of not restricting the regressions to the surgery-eligible population.

All regressions also included the following control variables: age, sex (female indicator), and race/ethinicity (non-Hispanic white, Hispanic white, black [Hispanic and non-Hispanic], other). For the MEPS regression, individual fixed-effects models were used to control for unobservable time-invariant characteristics of individuals. Because only 1 year of data were available for the NHWS regression, a traditional ordinary least squares model was used to estimate δ.

The estimates of β and δ and estimates of α_i were combined as noted in the "Methodological Overview" section to generate quarterly percentage savings in absenteeism and presenteeism. To convert these percentage savings into dollars, these values were multiplied by the absenteeism and presenteeism costs attributable to obesity among the surgery-eligible population. These estimates were generated by using the NHWS data following the identical approach presented in Finkelstein et al. [11], with the only difference being that the obesity category variable was redefined to include only those individuals who were obese and eligible for bariatric surgery (as defined above).

The quarterly monetized savings in absenteeism and presenteeism postbanding were then combined with the direct medical cost savings to estimate total quarterly savings resulting from an LAGB procedure. These savings were combined with the direct and indirect costs of the procedure to estimate time to breakeven and net costs at the end of 5 years. Direct costs for an LAGB procedure were taken directly from Finkelstein et al. [12]. Work-loss estimates were taken from Fisher [13] and monetized by using the approach presented in Finkelstein et al. [11].

Fisher reports that the average number of days prior to returning to normal activity was 7.2 and that 15.8 days were required for a full recovery. These were converted into 5.2 days of absenteeism (7.2 minus 2 weekend days) and 3.3 days of presenteeism. The presenteeism estimate was calculated by taking 15.8 days and subtracting out 7.2 days of absenteeism, two additional weekend days, and assuming that patients are working at 50% productivity for the 6.6 days prior to full recovery.

Confidence intervals for the net cost estimates were generated by combining each of 1000 bootstrapped iterations from the direct cost estimates with a random draw from the preferred model specification from the absenteeism and presenteeism estimates assuming a bivariate normal distribution with means equal to the estimated elasticities, variances equal to the square of the estimated standard errors from the corresponding regression model, and covariance based on the estimated standard errors and an assumed correlation of $r = 0.5$. We also conducted additional sensitivity analyses for the time to breakeven by using the extreme values of β and δ generated from the alternative regression models and using the primary estimates but assuming the two elasticity estimates are 1) uncorrelated or 2) perfectly correlated ($r = 1.0$).

Table 1 – Summary statistics for individuals eligible for LAGB in the Medical Expenditure Panel Survey (MEPS) and the National Health and Wellness Survey (NHWS).

	MEPS (n = 134)	NHWS (n = 2164)
Age (y), mean (SE)	43.2 (1.1)	44.7 (0.2)
Male (%)	49.3	49.1
Race (%)		
White [reference]	61.5	67.8
Black	20.1	16.4
Hispanic	14.5	9.9
Asian	0.0	1.0
Other	3.9	4.9
Body mass index (kg/m^2), mean (SE)	44.1 (0.4)	42.9 (0.1)
Percentage with zero medical expenditures	12	N/A
Absenteeism days,* mean (SE)	7.7 (1.9)	14.7 (1.0)
Percentage with zero absenteeism days	39	37
Presenteeism days, mean (SE)	N/A	58.0 (1.4)
Percentage with zero presenteeism days	N/A	55.0

LAGB, laparoscopic adjustable gastric banding; N/A, not applicable/available; SE, standard error.

* Absenteeism is measured differently in MEPS and NHWS. MEPS includes the following question in each interview round that allows for quantifying annual work loss due to illness or injury: "How many days did [respondent] miss a half day or more of work due to health problems?" Absenteeism is measured in NHWS using the following question: "During the past seven days, how many hours did you miss from work because of your health problems?" These estimates were then annualized.

Results

Table 1 presents summary statistics for the MEPS and NHWS samples used in the primary analysis. The two samples have similar age and gender profiles. Likely because it is an Internet panel, the NHWS sample includes more whites and fewer blacks and Hispanics. The average BMI among the surgery-eligible sample is also slightly larger in MEPS than in NHWS, 44.1 (standard error [SE] = 0.4) versus 42.9 (SE = 0.1). MEPS respondents who are eligible for bariatric surgery report $4050 (SE = 790) in annual medical expenditures. They also report, on an annualized basis, an average of 7.7 days (SE = 1.9) where at least a half-day or more of work was missed because of health problems. However, 12% and 39% of the observations included zeros for medical expenditures and work loss, respectively.

Annualized estimates of absenteeism among the surgery-eligible NHWS sample revealed 14.7 days (SE = 1.0) of work loss on average, with 37% of individuals missing zero days. This estimate is more than double the MEPS estimate. This difference likely results from differences in how the question was asked. NHWS captures work loss of less than half a day, whereas MEPS does not. The average number of presenteeism days for a surgery-eligible individual in NHWS was 58.0 (SE = 1.4), with 55% reporting zero presenteeism days. Using the approach presented in Finkelstein et al. [11], when limited to obesity-attributable work loss among the surgery-eligible population, the annual obesity-attributable absenteeism and presenteeism estimates are reduced to 7.0 days and 21.0 days, respectively. When monetized, this equates to $620 per quarter for absenteeism and $1870 per quarter for presenteeism.

Column 1 of Table 2, reprinted from Finkelstein et al. [12], presents average quarterly savings post-LAGB. Dividing these savings by costs for the control group in the corresponding quarter generated the estimated α_is. The average percentage savings (relative to the control group) post–gastric banding are 38%, with estimates ranging from 27% (quarter 3) to 63% (quarters 15 through 20 pooled).

Table 3 presents estimates β, δ, and β times δ. The estimate of β, which represents the percentage change in absenteeism for a given percentage change in medical expenditures, from the primary specification is 0.31, meaning that, for example, a 10% decrease in medical expenditures in a given quarter would generate a 3.1% decrease in quarterly absenteeism costs. Various model specifications and samples lead to estimates of β between 0.24 and 0.57.

The estimate of δ, the percentage change in presenteeism for a given percentage change in absenteeism, from the primary specification was 0.49, with estimates ranging from 0.12 to 0.58. Multiplying β times δ provides an estimate of the percentage change in presenteeism for a given percentage change in medical expenditures. Using the primary estimates of β times δ yields an estimate of 0.15 (0.31×0.49), revealing that, following the example above, a 10% reduction in quarterly medical expenditures would yield a 1.5% reduction in quarterly presenteeism costs.

Finkelstein et al. [12] reported that the direct medical cost of a gastric banding procedure is $20,030. Monetizing the indirect costs reported in Fisher [13] and applying the assumptions presented above to split the costs between absenteeism and presenteeism

Table 2 – Quarterly savings in medical expenditures post-LAGB.

Quarter relative to band placement	Quarterly reduction in medical expenditures* (95% CI)†	Percentage reduction in medical expenditures relative to control group (α_i)‡ (95% CI)
2	−590 (−910 to −270)	36 (30–42)
3	−380 (−690 to −80)	27 (20–34)
4	−670 (−1000 to −340)	31 (24–38)
5	−1210 (−2160 to −260)	35 (19–51)
6	−1510 (−2050 to −970)	37 (27–47)
7	−810 (−1390 to −230)	23 (10–36)
8	−880 (−1550 to −210)	24 (9–39)
9	−1160 (−1870 to −450)	28 (12–44)
10	−2170 (−3550 to −790)	43 (22–64)
11	−3090 (−4560 to −1620)	50 (33–67)
12	−1590 (−2790 to −390)	42 (21–63)
13	−1780 (−3510 to −50)	37 (7–67)
14	−2820 (−5640 to 0)	53 (20–86)
15–19 (pooled)	−1140 (−1510 to −770)	63 (36–90)

CI, confidence interval; LAGB, laparoscopic adjustable gastric banding.
* LAGB procedure occurs on day 1 of quarter 1.
† Confidence intervals based on 1000 bootstrapped iterations of the direct cost data.
‡ Percentage reduction in medical expenditures relative to control group is generated from results presented in Hammond [9].

generated indirect cost estimates of $1900 and $1280, respectively, suggesting that the total cost associated with a gastric banding procedure is $23,210. Table 4 combines these cost estimates with estimates of the α_is, β, and δ and the obesity-attributable costs in the absence of the procedure to generate net savings in each quarter resulting from gastric banding.

Column 1 of Table 4, reproduced from Finkelstein et al. [12], presents the net costs of LAGB when focusing solely on direct medical expenditures. These data reveal that the costs of the procedure are recovered in 16 quarters (4 years) when focusing solely on direct medical expenditures. Column 2 provides results for medical and absenteeism costs combined. When focusing on these cost drivers only, the time to breakeven remains at 16 quarters; reductions in absenteeism over this time period are exactly offset by the number of days missed required to obtain the procedure. Column 3 presents results for medical, absenteeism, and presenteeism costs combined. Using all three cost categories, the time to breakeven is reduced by half a year, from 16 to 14 quarters. Best-case estimates of β and δ reduce the time to breakeven to 13 quarters. Using the Fisher et al. estimates of work loss resulting from the procedure, worst-case estimates suggest that the time to breakeven remains at 16 quarters.

Although inclusion of absenteeism and presenteeism costs has only a modest effect on time to breakeven, beyond the breakeven period estimated savings are much larger when indirect costs are considered. Focusing on 5-year savings, Finkelstein et al. [12] reported net savings in medical expenditures from a gastric banding procedure to be $4970 (±$3090). Including absenteeism costs increases net savings to $6180 (±$3550). Savings are further increased to $10,960 (±$5864) when all three cost categories are included.

Discussion

As noted in the Introduction, indirect costs are the single largest driver of the costs of obesity, yet, because of data limitations, these costs are typically omitted from cost-effectiveness and cost-benefit analyses of obesity interventions. Given that employers bear a large share of the indirect costs of obesity and are ultimately re-

Table 3 – Estimates of the elasticity between medical expenditures and absenteeism from the Medical Expenditure Panel Survey (MEPS) and the elasticity between absenteeism and presenteeism from the National Health and Wellness Survey (NHWS).

Estimate	Percentage change in absenteeism for a given percentage change in medical expenditures (β)	Percentage change in presenteeism for a given percentage change in absenteeism (δ)	Percentage change in presenteeism for a given percentage change in medical expenditures ($\beta \times \delta$)
Preferred model specification (95% CI)	0.31 (0.22–0.39)*	0.49 (0.43–0.55)*	0.15 (0.005–0.33)*
Range based on alternate model specifications	[0.24–0.41]†	[0.12–0.58]‡	[0.03–0.33]

CI, confidence interval; OLS, ordinary least squares.
* Estimate is based on 1000 simulations drawn from the sample mean and variance of β and δ assuming a bivariate normal distribution with a correlation of 0.5 between β and δ.
† The lower bound estimate is from the fixed effects full sample regression after adjusting zero values as in the primary specification. The upper bound estimate is from the cross-sectional OLS model after similar adjustment for zero values.
‡ The lower bound estimate is from the OLS model on the surgery-eligible sample without adjusting zero values. The upper bound estimate is from the OLS model on the full sample after adjusting zero values as in the primary specification.

Table 4 – Net costs and time to breakeven post-LAGB.

Quarter	Medical expenditures only (95% CI)	Medical expenditures + absenteeism (95% CI)*	Medical expenditures + absenteeism + presenteeism (95% CI)*
−1	$1030 (750–1310)	$1080 (770–1390)	$1190 (800–1580)
1	$20,030 (19,750–20,310)	$21,930 (21,310–22,550)	$23,210 (22,550–23,870)
2	$19,440 (18,940–19,940)	$21,200 (20,410–21,990)	$22,200 (21,330–23,070)
3	$19,060 (18,400–19,720)	$20,710 (19,770–21,650)	$21,500 (20,360–22,640)
4	$18,390 (17,600–19,180)	$19,920 (18,820–21,020)	$20,470 (19,010–21,930)
5	$17,180 (16,220–18,140)	$18,570 (17,394–19,750)	$18,850 (17,000–20,700)
6	$15,670 (14,460–16,880)	$16,910 (15,460–18,360)	$16,920 (14,580–19,260)
7	$14,860 (13,390–16,330)	$16,010 (14,310–17,710)	$15,850 (13,140–18,560)
8	$13,980 (12,250–15,710)	$15,040 (13,050–17,030)	$14,690 (11,550–17,830)
9	$12,820 (10,760–14,880)	$13,770 (11,480–16,070)	$13,220 (7860–18,580)
10	$10,650 (7860–13,440)	$11,440 (8460–14,420)	$10,570 (6100–15,040)
11	$7560 (3800–11,320)	$8160 (4270–12,050)	$6930 (1360–12,500)
12	$5970 (1640–10,300)	$6420 (2020–10,820)	$4880 (−1380 to 11,140)
13	$4190 (−790 to 9170)	$4500 (−560 to 9560)	$2690 (−4370 to 9750)
14	$1370 (−4720 to 7460)	$1480 (−4840 to 7800)	**$700 (−9110 to 7710)**
15	$230 (−5880 to 6340)	$110 (−6290 to 6510)	$2510 (−11,370 to 6350)
16	**$910 (−7030 to 5210)**	**$1250 (−7769 to 5269)**	$4310 (−13,680 to 5060)

* Confidence intervals were generated by combining each of 1000 bootstrapped iterations from the direct cost estimates with a random draw from the preferred model specification from the absenteeism and presenteeism estimates assuming a bivariate normal distribution with means equal to the estimated elasticities, variances equal to the square of the estimated standard errors from the corresponding regression model, and covariance based on the estimated standard errors and a correlation equal to 0.5.

sponsible for making coverage decisions for their employees, this omission represents a significant limitation.

This analysis presented a novel strategy for estimating indirect cost savings in the absence of longitudinal data pre- and postintervention. The approach relied on estimating the relationship between changes in medical expenditures and corresponding changes in absenteeism and presenteeism. Implementation issues aside, the logic behind the approach is straightforward. Interventions that improve health should simultaneously reduce medical expenditures, which can be directly assessed via longitudinal claims data, and generate indirect cost savings through reductions in absenteeism and presenteeism, which can be indirectly quantified by estimating the relationship between changes in medical expenditures and changes in absenteeism and presenteeism.

Application of this approach to estimate the net costs of gastric banding revealed a high correlation between medical expenditures, absenteeism, and presenteeism among the surgery-eligible obese population. Finkelstein et al. [12] estimated an average quarterly savings postbanding of 38% ($1400). Based on this value and the elasticity estimates presented in the preceding section, these results reveal average quarterly indirect cost savings of 12.2% ($390) and 6.0% ($70) for absenteeism and presenteeism, respectively. When indirect costs are included, the estimated time to breakeven is reduced from 4 to 3.5 years and the potential savings to employers beyond this period are greatly increased. These results show a 222% increase in the 5-year savings alone, from $4,950 to $10,960, highlighting the importance of incorporating indirect costs into the analysis.

As noted in the direct cost manuscript upon which these estimates are based, much of the savings in direct costs were generated through lower use of inpatient services and, to a lesser extent, lower payments for prescription drugs partly as a result of reductions in the use of diabetes medications [12]. Although the relationship between medical expenditures and absenteeism and presenteeism was estimated by using cross-sectional data, lower use of inpatient services would be expected to lead to less work loss, suggesting that the estimated relationships are internally consistent. The net savings are also consistent with the medical literature. A recent review of several prior meta-analyses of LAGB reports that all studies reporting on comorbidities showed significant resolution or improvement of type 2 diabetes mellitus, hypertension, and dyslipidemia. Sleep apnea was also significantly improved [14].

Although this study has much strength, there are some limitations. One limitation is that the results hinge on obtaining unbiased estimates of quarterly savings in direct medical expenditures. These estimates are based on data obtained from the MarketScan® Commercial Claims and Encounters Database between January 1, 2003, and March 31, 2008 [15]. The database included full claims from approximately 100 large payers representing millions of covered lives. Moreover, a supplemental database allowed for an identification of a subset of individuals who had a self-reported BMI of more than 35 kg/m^2 in a health risk assessment. This supplement was used to identify a sample of surgery-eligible patients who, after propensity score matching, were used as a control group. The longitudinal nature of the data and the ability to merge BMI data make this one of the few data sets available for conducting this type of analysis. The results, however, may not generalize beyond members of these health plans. Moreover, any biases in the direct cost estimates will be exacerbated when indirect costs are included because the indirect cost savings are a function of the savings in direct costs. In addition, both absenteeism and presenteeism were based on self-report; objective measures of these values would be preferable.

It would also be preferable to estimate the relationship between medical expenditures, absenteeism, and presenteeism by using longitudinal data; however, only 2 years of MEPS data and 1 year of NHWS data were available. Moreover, because the two elasticity estimates β and δ were estimated from separate data sets, we could not directly estimate their covariance. In reality, the elasticities are likely to be positively correlated because medical expenditures, absenteeism, and presenteeism are all driven by the underlying health of the individual. To account for this, we assumed a correlation of 0.5 between β and δ when estimating the standard errors for the 5-year net savings estimates. This assumption does not affect the point estimates, but it does affect the standard errors. If the estimates of β and δ were perfectly correlated ($r = 1$), then the standard error for the 5-year net savings would increase by 29%, whereas if β and δ were uncorrelated, the standard error would be 26% smaller.

Finally, there are several sources of uncertainty that our estimates do not take into account. The primary estimates report standard errors based on uncertainty in the direct cost estimates and the estimated elasticities. We also present sensitivity analyses to gauge the impact of different sample and modeling strategies on the results. Additional sources of uncertainty, such as variation in absenteeism and presenteeism time resulting from the initial LAGB procedure, however, were not considered. To address these limitations, long-term registries or clinical trials of LAGB patients should incorporate routine data collection of all these outcomes in a single comprehensive data set. Including additional measures of burden, such as care giving and transportation costs, would allow for a more accurate accounting of the net costs of LAGB.

Conclusions

This study presented a novel approach for estimating indirect costs savings when savings in direct costs are available. Application of the approach to gastric banding among surgery-eligible obese employees revealed that inclusion of indirect costs improves the business case for the procedure. Future studies should attempt to validate this approach by comparing the results to those generated from longitudinal data postintervention, and, if successful, apply it to other populations and treatments where data on indirect cost savings are not readily available.

Source of financial support: This research was supported by Allergan, Inc.

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